



## VCAS™ White Pozzolans: A Green Product for White Concrete

**What the innovation is:** VCAS (Vitreous Calcium Alumino-Silicate) white pozzolans are new custom-engineered, high performance supplementary cementing materials for use in white concrete. They are sustainable “Green” building products derived entirely from glass fiber manufacturing waste. With this technology, the glass industry can prevent the landfilling of about 200,000 tons of waste glass fiber annually, along with its associated negative environmental impact. The concept will save a net amount of energy (estimated at 1.75-trillion BTU) consumed by eliminating the manufacture of white cement, the material replaced by the processed waste e-glass. The technology also reduces the amount of CO<sub>2</sub>, NO<sub>x</sub>, and other air pollutants emitted during the manufacture of the replaced cement. VCAS pozzolans provide a cost-effective means of introducing “Green” sustainable values into white concrete materials, hitherto impossible, while improving quality and long-term durability. The products and technology have been patented under US 6,776,838 “White Pozzolan Composition and Blended Cements Containing Same,” issued Aug 17, 2004, with two other patents pending in the U.S. and Europe.

**Why it is innovative:** Chemically, VCAS pozzolans are comprised largely of oxides of Si, Al and Ca with no deleterious impurities. Unlike silica fume, fly ash and slag, VCAS pozzolans are free of Fe, Mn, and other undesirable color-inducing impurities, making them ideally suited for all applications using white cement — such as mortars, stuccos, plasters, terrazzo, artificial stone, cast-in-place or precast concrete products, and pigmented concrete. Use in the newly promulgated white concrete highway median barriers is a particularly attractive and technically applicable market for VCAS products. A second major product differentiation is that the glassy matrix of VCAS pozzolans provides low water demand and improved rheology in the plastic state, in marked contrast to the high water demand “sticky” high reactivity pozzolans such as silica fume and metakaolin. The feedstock for VCAS is derived from highly refined e-glass reinforcing fiber; consequently, the composition is very consistent — probably the tightest in the cement powder industry — with zero crystalline silica. The CaO-SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> proportions, the low alkali metal content, the high reactive silica content, and the 100% amorphous structure are unique to e-glass and are ideal for a pozzolanic additive in hydraulic concrete. In contrast, post-consumer container glass is unacceptable for this application due its very high alkali content. Like other pozzolans, VCAS white pozzolans react with calcium hydroxide produced during the hydration of Portland cement to form additional cementitious compounds such as C-S-H and C-A-S-H which fill in pores and densify the concrete matrix. The reactivity of the VCAS pozzolans is directly controlled by the particle size distribution produced during manufacture. Currently, the VCAS pozzolans are being marketed in two grades: VCAS-8 (8 μm med), comparable with slag; and VCAS-micronHS (3 μm med), comparable with silica fume and metakaolin.

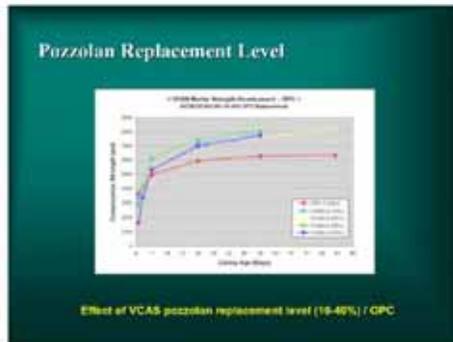
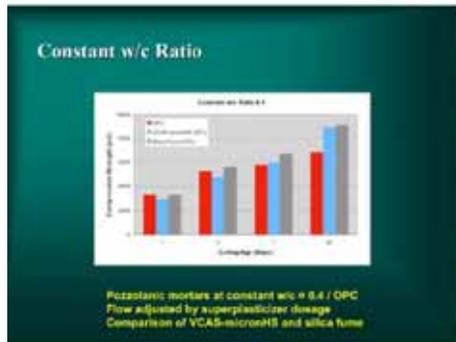
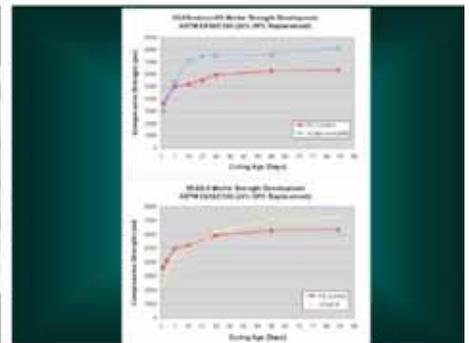
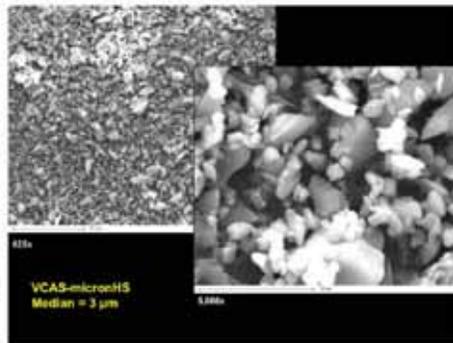
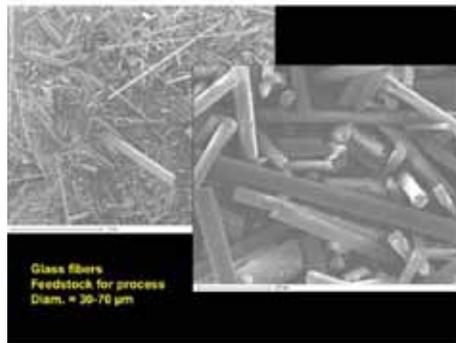
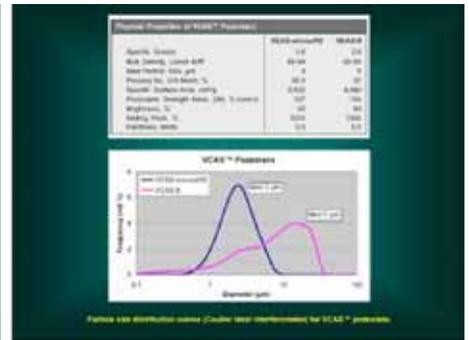
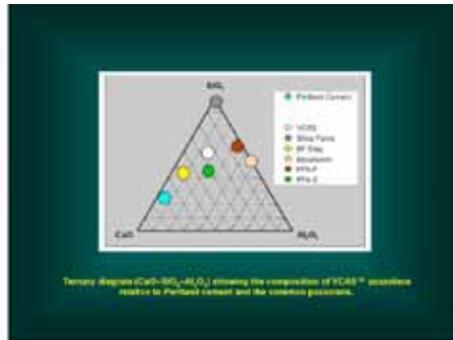
**What it changed or replaced:** With their low water demand and high performance, VCAS pozzolans provide a cost-effective alternative solution to MK and SF for improving the quality and sustainability of white and gray concrete. VCAS pozzolans are post-industrial products with an important role to play in sustainable construction by increasing service life and reducing net greenhouse gas emissions (GHG) for a cubic yard of concrete. VCAS pozzolans are non-toxic and classed as a nuisance dust, in common with other fine particulate industrial minerals.

**Where and when it originated, has been used, and is expected to be used in the future:** The VCAS pozzolan technology has been under development for over 5 years and was introduced by Vitro Minerals to the concrete industry at the Fall ACI Convention in Kansas City and the World of Concrete in Las Vegas in January 2006. It originated from research conducted by the proposer (RTH) with Albacem LLC of Peoria, Illinois. Commercial development of the technology by Albacem was supported by a U.S. DOE Inventions & Innovations Award during 2004-2005. Early this year, Albacem partnered with Vitro Minerals Inc. and granted an exclusive license to Vitro to build conversion plants, produce materials, and market the new products to the cement and concrete products markets. Further information is available at Vitro’s website: [www.vitrominerals.com](http://www.vitrominerals.com).

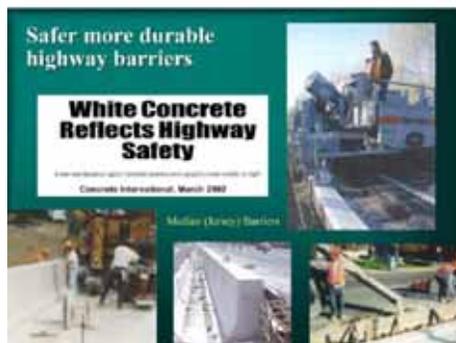
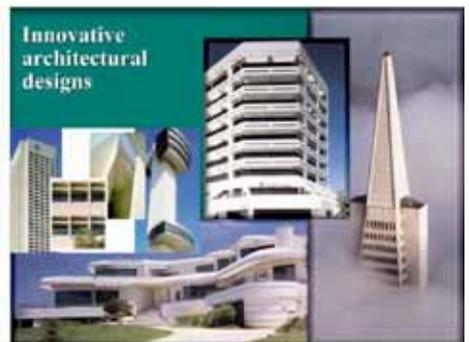
### Specific Innovations

- **High Performance:** Pozzolanic activity comparable to SF and MK when tested in accordance with ASTM C618 and ASTM C1240. VCAS-micronHS exceeds the control before 3 days, making it an excellent choice for high performance applications where high early strength is required. Long-term strength can be enhanced by 25% or more.
- **Blended pozzolanic cements** produced with VCAS pozzolans (up to 30w/w% or more) comfortably exceed the requirements of ASTM C1157: Standard Performance Specification for Hydraulic Cement.
- **Superior powder handling** compared with silica fume and metakaolin. VCAS pozzolans are as white as, or whiter than, white cement. Tight process control provides consistent product quality and physical properties.
- **Improved durability of white cement:** VCAS provides improved sulfate resistance; control of alkali silica reaction; reduced permeability and chloride ion penetration; reduced efflorescence and staining. These features apply to gray cement also.
- **Benefits:** *Fresh Concrete:* Improved workability; reduction in water requirements; ease of dispersability; reduction in superplasticizer dosage; reduction in bleeding; reduction in aggregate segregation. *Hardened Concrete:* Increased compressive strength; decreased permeability; reduced efflorescence; increased durability. *Added-Value:* Mix-color neutrality and brightness; improved retention of mold detail; sustainability.

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- Enhanced Durability with VCAS Pozzolans**
- Improved sulfate resistance of white concrete
  - Control of alkali silica reaction
  - Reduced permeability and chloride ion penetration
  - Reduced efflorescence and staining



- Sustainability**
- VCAS pozzolans are Green building products.
  - Reduced GHG emissions, energy savings, and conservation of resources by replacement of cement.
  - Increased service life of structures through improved durability.
  - Solid waste elimination reduces environmental impact of glass manufacturing operations.
  - LEED Certification.

**VCAS White Pozzolans**

Custom engineered, high performance pozzolans for use in sustainable white and grey cement and concrete products.